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Analysis of Multi-Storey Building with and without Floating Column

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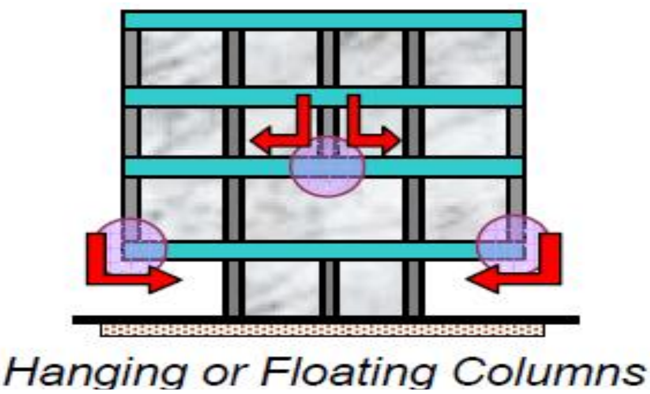
***Abstract*— Many buildings in recent times have planned and constructed for architectural complexities such as building with floating columns at various levels and locations. These floating columns are highly disadvantageous in building built in seismically prone areas. Present study examines the effect of floating columns in building. Models are developed for multi-storey (G+5) buildings with and without floating columns to carry out comparative study of structural parameters such as natural drift values, base shear and horizontal displacement under seismic excitation.**

***Keywords*— Floating column, Normal building, ETABS**

INTRODUCTION

A column is supposed to be a vertical member starting from foundation level and transferring the load to ground. The term floating column is a vertical element which at its lower level rests on a beam which is a horizontal member. The beam in turn transfers the load to other column below.

There are many projects in which floating columns are adopted, especially above the ground floor, where transfer girder is employed, so that more open space is available in the ground floor. These open space may is utilized as party hall, assembly hall and parking purpose. The transfer girder has to be designed and detailed properly, especially in earthquake zones. The column acts as concentrated load on beam. As far as analysis is concerned, the column is often assumed pinned at therefore taken as a point load on the transfer beam.



I. OBJECTIVE

The main objective of this study is to analyze the G+5 storey building with floating columns at different locations and also to check the storey displacement, storey drift and storey shear for floating columns at various locations.

II. MODELLING OF BUILDING

The building considered is regular G+5 normal RC building of dimension of plan with 24mX24m, the building are considered to be located in Zone V as pre IS 1893-2002.The Table 1 shows structural data of the building.

I)Material Data		
1	Grade of concrete	M30
2	Grade of Steel	Fe500
3	Unit weight of RCC	25kN/m2
II) Structural Data		
1	Type of structure	SMRF
2	Type of soil	Medium soil
3	Size of beam	230mm X450mm
4	Size of column	230mmX450mm
5	Depth of slab	150mm
6	Thickness of exterior wall	230mm
7	Thickness of interior wall	150mm
III) Architectural Data		
1	Number of stories	G+5
2	Floor height	3mt
3	Dimension of plan	24mX24m
IV)Seismic Data		
1	Siesmic Zone	V
2	Response reduction factor	5
3	Importance factor	1
4	Damping ratio	5%
V) Loads		
1	Live load	3kN/m2
2	Floor finish	1.5kN/m2
3	Wall load on exterior frame	12kN/m
4	Wall load on interior frame	6kN/m

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Case 1: RC structure without Floating column i.e., Normal (G+5) storey building

Case 2: RC structure with floating column, Columns removed in corner of exterior frame

Case 3: RC structure with floating column, Columns removed in middle of exterior frame

Case 4: RC structure with floating column, Columns removed in interior frames.

III. MODELS OVERVIEW

The plan and elevation of 4cases buildings are shown in fig

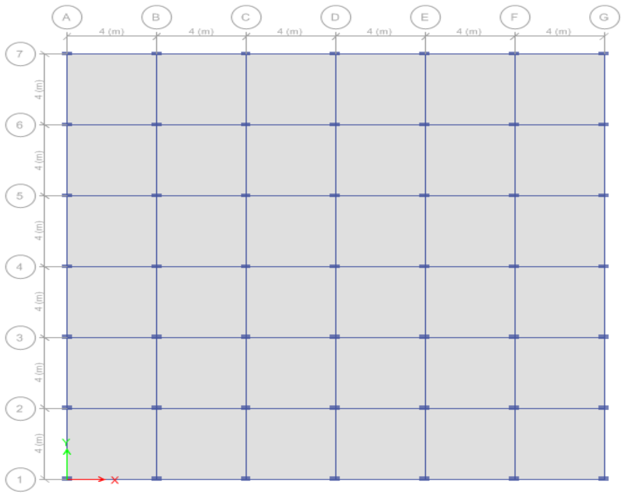

Fig.1- Plan of Normal (G+5) storey building (Case 1)

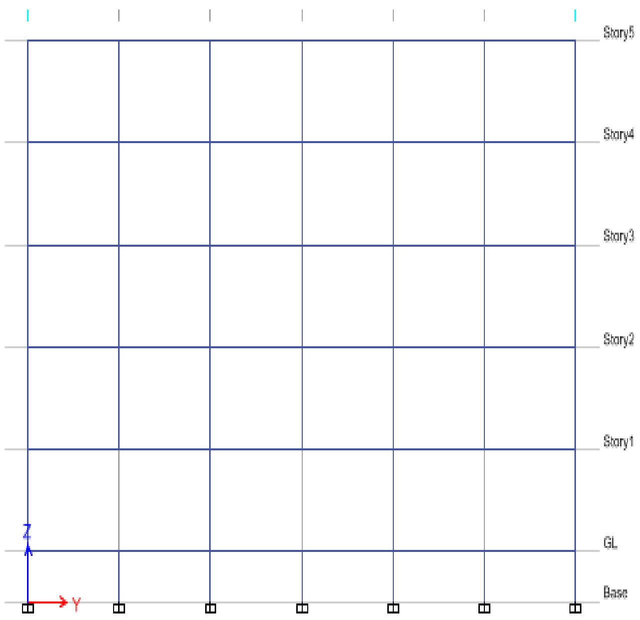

Fig.1a-Elevation of Normal (G+5) storey building (Case1)

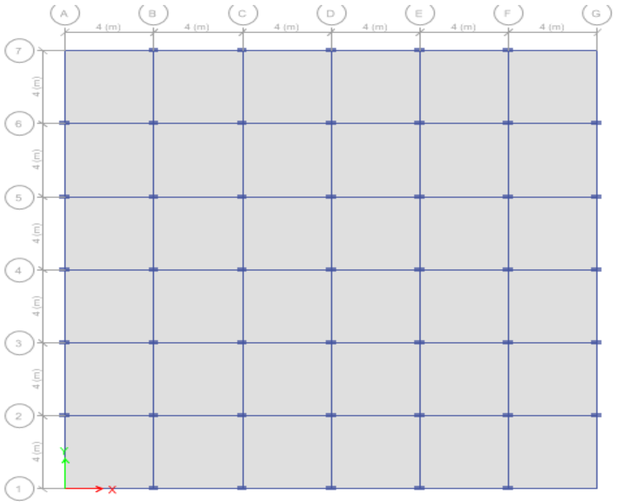

Fig 2.Plan of building with Columns removed in corner of exterior frame (Case 2)

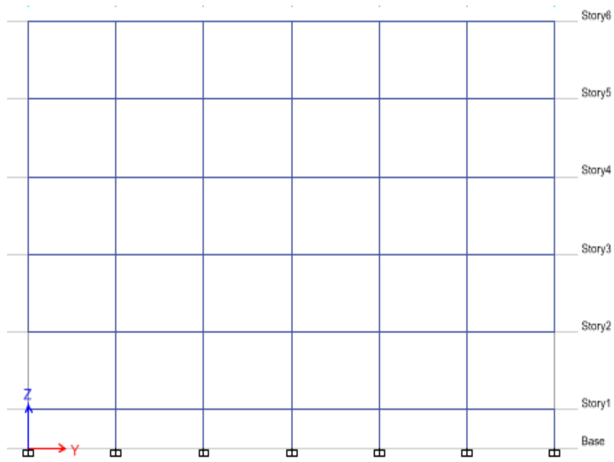

Fig 2a- Elevation of building with Columns removed in corner of exterior frame (Case 2)

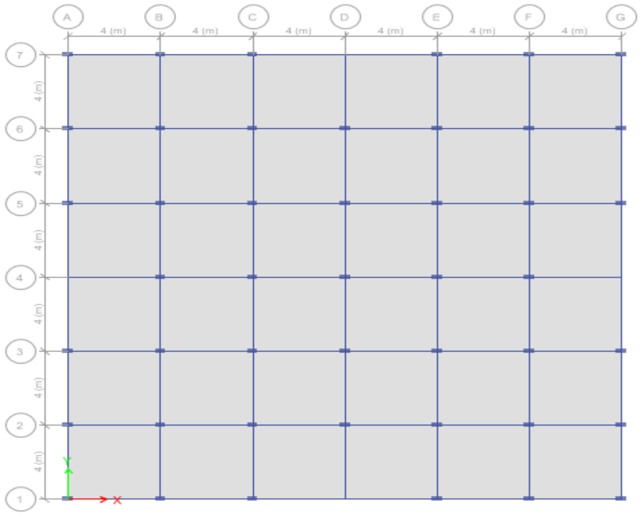

Fig 3 Plan of building with Columns removed in middle of exterior frame (Case 3)

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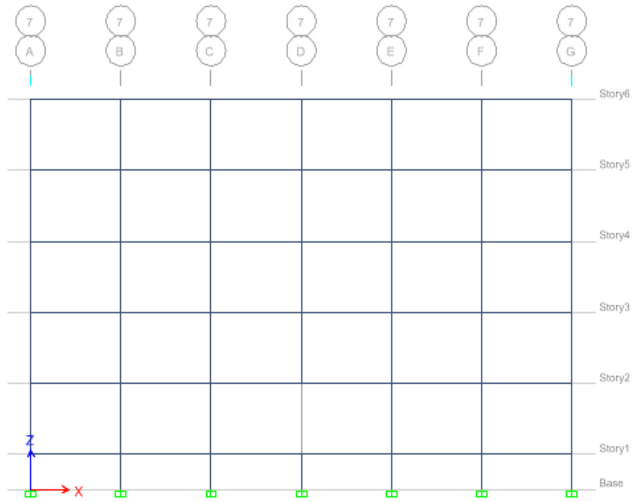

Fig 3a.Elevation of building with Columns removed in middle of exterior frame (Case 3)

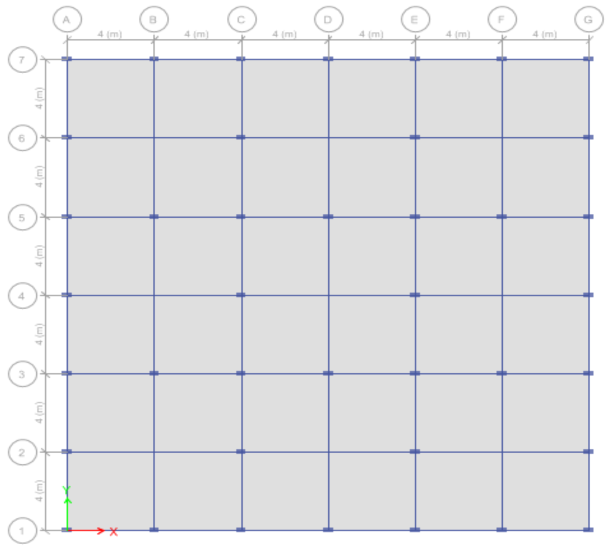

Fig.4 Plan of building with Columns removed in interior frame (Case 4)

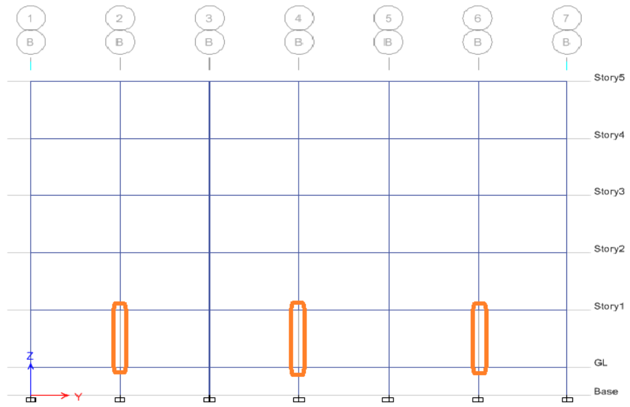

Fig 4a.Elevation of building with Columns removed in interior frame (Case 4)

IV. COMPARISION

A. Storey displacement

The Lateral movement of a building which is caused by the lateral force is known as storey displacement. With the introduction of floating column in a building, storey displacement increases. Since the columns of storey one are removed, storey displacement is maximum for storey one.

Table 2: Displacement values of G+5 storey building subjected to seismic load in X direction

Storey	**Case1**	**Case 2**	**Case 3**	**Case 4**
GL	0.9	0.8	0.9	0.9
1	5.8	5.9	6.5	6
2	11.2	11.4	11.7	11.4
3	16.1	16.5	16.6	16.3
4	20	20.5	20.3	20.2
5	22.4	23.1	22.7	22.7

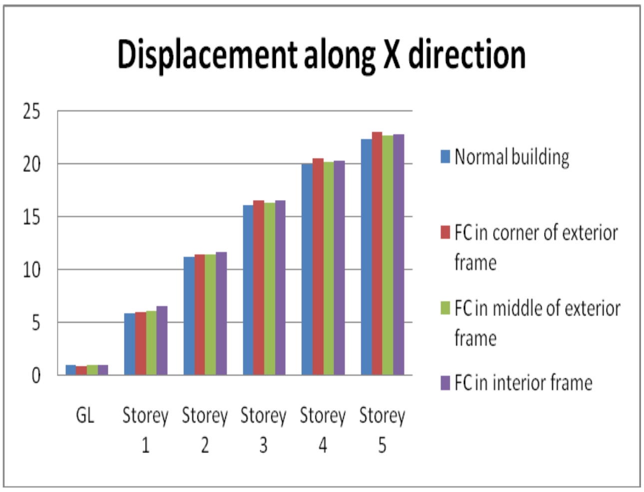

Fig-5: Displacement values of G+5 storey building subjected to seismic load along X direction

Table-3: Displacement values of G+5 storey building subjected to seismic load in Y direction

storey	Case1	Case2	Case3	Case4
GL	1.2	1.1	1.1	1.1
1	8.8	9.1	10.1	9.2
2	16.5	16.8	17.6	16.8
3	23.5	23.9	24.3	23.8
4	29.1	29.6	29.7	29.4
5	32.4	33.1	32.9	32.7

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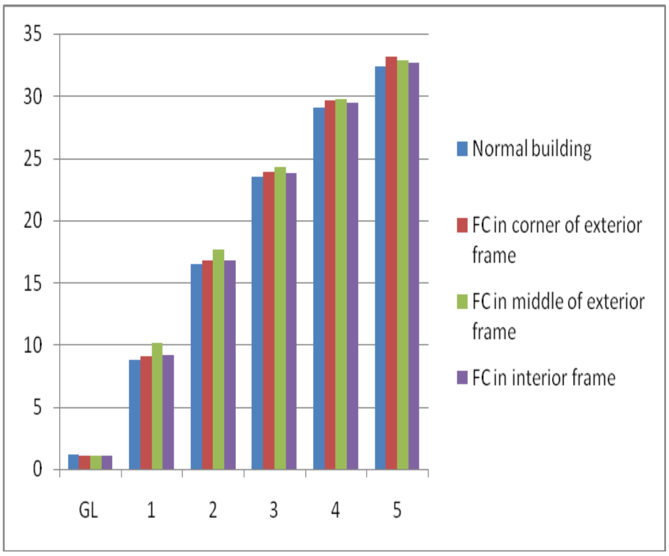

Fig 6: Displacement values of G+5 storey building subjected to seismic load along Y direction

The maximum storey displacement for Case 1 increases by 3.12%, 1.34% of Case 2, 3 and 4 respectively along X direction and about 2.16%, 1.54%, 0.93% along Y direction.

B. Storey drift

Storey Drift is defined as the difference between the relative storey displacements. Storey displacement is directly proportional to the storey displacement. As we introduce floating column in a building, storey drift increases as storey displacement increases.

Storey drift goes on decreasing as we move towards top stories. Storey drift is maximum for storey one since the storey displacement is maximum for storey one.

Table 4: Drift values of G+5 storey building subjected to seismic load in X direction

Storey	Case1	Case2	Case3	Case4
GL	0.000866	0.000814	0.000801	0.000775
1	0.00136	0.001315	0.001312	0.001271
2	0.001684	0.001643	0.001644	0.001592
3	0.001829	0.001792	0.001794	0.001754
4	0.001717	0.00172	0.00164	0.001791
5	0.000566	0.000577	0.000571	0.000574

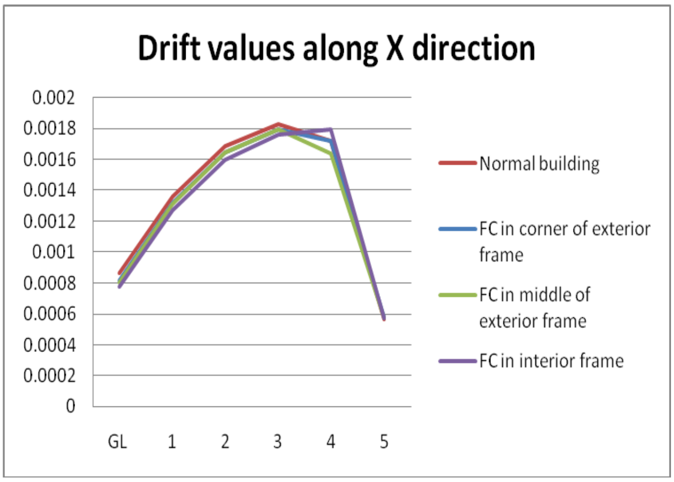

Fig 7: Drift values of G+5 storey building subjected to seismic load along X direction

Table 5: Drift values of G+5 storey building subjected to seismic load in Y direction

Storey	Case1	Case2	Case3	Case4
GL	0.00109	0.001154	0.00111	0.001066
1	0.001871	0.001898	0.00186	0.001797
2	0.00234	0.002359	0.002323	0.002246
3	0.002575	0.002585	0.002552	0.002489
4	0.002534	0.002672	0.002687	0.003002
5	0.000775	0.000755	0.000762	0.00076

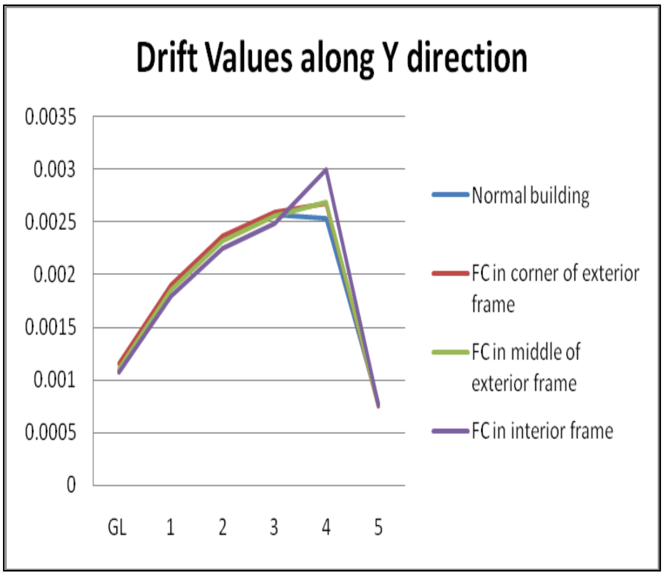

Fig 8: Drift values of G+5 storey building subjected to seismic load along Y direction

The maximum storey drift value for model 1 increases by 2.02%, 1.91% and 4.1% of case 2, 3,4 respectively along X direction and about 0.38%, 0.89%, 3.34% along Y direction.

C. Storey shear

The forces which are induced at every storey during earthquake are known as the storey forces. Storey forces induced in normal building will be more than building containing floating column. For a building, storey forces goes on increasing for lower stories and it will be maximum for bottom storey.

Table 6: Storey shear values of G+5 storey building subjected to seismic load.

Storey	Case1	Case2	Case3	Case4
GL	888.1014	859.9193	869.6314	855.0714
1	1507.712	1468.1334	1484.7149	1459.8566
2	1885.5629	1836.0654	1856.8024	1825.7144
3	2078.344	2023.7858	2046.6429	2012.3765
4	2147.1452	2091.1367	2114.7884	2079.2136
5	2155.25	2098.4116	2122.1455	2086.4067

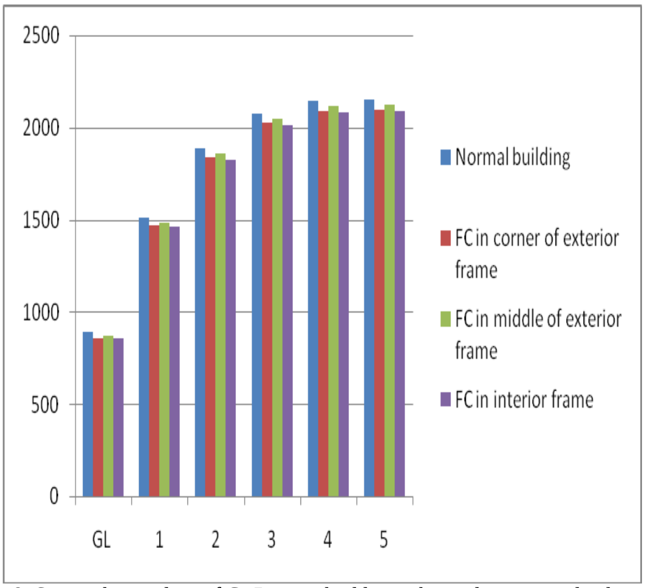

Fig 9: Storey shear values of G+5 storey building subjected to seismic load

The storey shear value for case 1 is decreased by 2.6%, 1.53% and 3.19% of case 2,3 and 4 respectively.

CONCLUSION

The study compares the difference between normal building and a building with floating column.

- Storey displacement increases as the height of the building increases. All the model displacement value is increases for the floating column buildings especially for the corner floating column building. Storey displacement increases or decreases depend upon the storey mass.
- Storey drift increases as storey displacement increases.
- Storey shear will be more for lower floors, than the higher floors due to reduction in weight from bottom to top floors.
- The base shear value decreases due to introduction of floating column.

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